Remarks

The Specification was amended for completeness to further support pending claims, which refer to the mean size of the drops of cleaning spray.

Claims 8-28 are currently pending. The Examiner is thanked for granting a telephonic interview on January 15, 2008. Claims 8 and 17 have been specifically amended in accordance with the interview. In total, Claims 8, 9, 12-14, 17-19 and 22-28 have been amended. Support for these claim amendments may be found, for example, as follows: (1) Paragraphs [22-26] for amendments to Claims 8, 17 and 23; (2) Paragraphs [19-23] for amendments to Claims 12 and 27; (3) Paragraph [25] for amendments to Claims 13 and 18; (4) Paragraphs [20] and [31-34] for amendments to Claims 22, 25 and 26; (5) Paragraphs [22-23] for amendments to Claim 24; and (6) Paragraph [19] for amendments to Claim 28.

New Claims 29-39 have been added. Support for these claims may be found, for example, as follows: (1) Paragraph [25] for Claims 29 and 31; (2) Amended paragraph [19] for Claims 30 and 32-33; (3) Paragraph [6] for Claims 34, 36 and 38; and (4) Paragraph [8] for Claims 35, 37 and 39.

The Applicant further submits herewith a Declaration of Thomas Wagner ("Wagner Decl."), Technical Director ("TD") of Gas Turbine Efficiency. ("GTE"), along with "Exhibit A," "Exhibit B," and "Exhibit C," pursuant to 37 CFR § 1.132.

The Applicant submits that no new subject matter has been added and respectfully requests entry of all claims into the official record.

Claim Rejections Under 35 U.S.C. § 112

The Applicant acknowledges the rejection of Claims 9, 11-12 and 18-22 under 35 U.S.C. § 112, second paragraph. In view of the amendments made to Claims 8, 12-13, 18, 22 and 25-27, the

Applicant submits that this ground for rejection is now moot. Accordingly, the Applicant requests withdrawal of this ground for rejection.

<u>Claim Rejections Under 35 U.S.C. § 102</u>

The Applicant acknowledges the rejection of Claims 8-28 under 35 U.S.C § 102(b) as being unpatentable over U.S. Patent No. 5,868,860 to Asplund ("Asplund") and U.S. Patent No. 6,073,637 to Hayward et al. ("Hayward"). In view of the following remarks and the claim amendments to independent claims 8, 17 and 23, the Applicant respectfully submits that each of Claims 8-33 are fully patentable over Asplund and Hayward.

Independent Claims 8, 17 and 23 are directed to methods and a system for cleaning a stationary gas turbine unit during operation. To this end, Claims 8, 17 and 23 recite (among other features) introducing a spray of cleaning fluid within an acceleration duct wherein the fluid is forced through a nozzle positioned at the acceleration duct. The acceleration duct as claimed and as shown for example in Figs. 1-3, includes a decreasing cross section in an air flow direction. The acceleration duct is also located adjacent to an inlet of a compressor. This decreasing cross section causes an area of extremely high air acceleration as shown, for example, in paragraph 19. Moreover, as shown for example in Fig. 3D, nozzles 32 are located within this high speed acceleration duct area. Method Claims 8 and 17 have been amended to include this limitation within the manipulative steps as required by the examiner in the telephonic interview of January 15, 2008.

In sharp contrast, Asplund sprays cleaning fluid onto and through an engine using nozzle openings that are directed into the engine rather than within a high acceleration air flow. (*See* Asplund, col. 1, line 65 through col. 2, line 13; col. 2, line 42 through col. 2, line 48). Moreover, Asplund claims a method of washing turbine compressors wherein the liquid is sprayed onto and

through the turbine compressors, and wherein at least one nozzle is directed towards and through the turbine compressor (*see* Asplund, Claim 1). Thus, the location of the nozzles and the introduction of cleaning fluid in Asplund occurs at low air acceleration areas unlike Applicant's cleaning fluid spray location, which occurs at the high velocity area of the acceleration duct.

Moreover, Asplund neither discloses nor shows nozzles located in an acceleration duct having a decreasing cross section located adjacent an inlet of a compressor. Fig. 1 shows nozzles located inside guide vanes. The cross-sectional area within the guide vanes is constant. Moreover, the cross sectional area of the engine or outer nozzle where the nozzles are located is also constant. Therefore, the nozzles shown in Fig. 1 are not in an area of decreasing cross section. Further, once the liquid passes through the guide vanes, the liquid enters an area of increasing cross section before contacting a duct fan or a compressor.

Fig. 2 shows an engine without guide vanes. The nozzles as shown are located upstream the compressor and duct fan. This area, as shown, has a constant cross-sectional area. Furthermore, Fig. 4 shows what is disclosed and claimed in Asplund; that liquid is sprayed onto and through the compressors and that the liquid follows the same routes as taken by air-borne contaminants. As shown by the first two arrows on the far left, the liquid particles are released in an air inlet of the engine in an area of constant cross section. The liquid then travels to an area downstream the air inlet of the engine and into an area of <u>increasing</u> cross section upstream the duct fan. The liquid then travels through the fan and some liquid enters the compressor while some liquid exits through an outer nozzle. Importantly, before entering the compressor, no area of decreasing cross section is shown. The only change in cross section is an increase downstream the air inlet of the engine.

Thus, Asplund does not disclose nozzles located in an acceleration duct having a decreasing cross section located adjacent an inlet of a compressor.

Likewise, Hayward's nozzle and location of cleaning fluid introduction occurs in a low or no acceleration location. (*see* Hayward, Figs. 5-8). As shown in Figs. 5-8, the nozzle location is upstream from any acceleration duct or compressor where all of the spray is introduced. In fact, the nozzles are shown outside the engine. Hayward's specification also teaches that the spray nozzle location is a considerable distance from the compressor because the spray angle of the nozzle is determined using the distance between the spray and the compressor (*see* Hayward, col. 4, lns. 10-13). Thus, Hayward neither teaches nor claims a turbine cleaning system having a spray introduced in an area of decreasing cross section and high velocity or nozzles located at a high velocity area or area of decreasing cross section.

For at least the distinguishing features discussed above, the Applicant submits that independent Claims 18, 17 and 23 are fully patentable over Asplund and Hayward. Consequently, the remaining claims, which depend upon independent Claims 8, 17 and 23, should also be considered patentable over Asplund and Hayward.

Claims Rejected under 35 U.S.C. § 103

The Applicant acknowledges the rejection of Claims 8-28 under 35 U.S.C. § 103(a) as being unpatentable over Asplund and Hayward. In view of the foregoing remarks relating to rejection over 35 U.S.C. § 102(b), the following remarks and the foregoing claim amendments, the Applicant respectfully submits that independent Claims 8, 17 and 23 and their associated dependent claims are now fully patentable over Asplund and Hayward. The Applicant respectfully requests reconsideration and withdrawal of this grounds for rejection.

The Examiner's assertion that Asplund and Hayward render the instant application obvious is respectively traversed. Merely manipulating the spray in Asplund and Hayward to attempt to achieve higher slip ratios would not yield the instant application because the spray nozzle location would first have to be moved to an entirely new location: the acceleration duct. As discussed above, Asplund contemplates a spray introduced onto and through an engine where the liquid follows the route of air borne contaminants. (*see* Asplund, col. 4 lns. 13-15 and Fig. 4). Hayward is predicated on the liquid being introduced upstream any area of decreasing cross section using changes in droplet size and pressure to clean throughout. (*see* Hayward, col. 4 lns. 10-12 and Figs. 4-8). Thus, it would not have been obvious for either Asplund or Hayward to move nozzles into an engine in an area of decreasing cross section where air flow is accelerated.

In addition and as stated above, Applicant submits herewith a Declaration of Thomas Wagner ("Wagner Decl."), along with "Exhibit A," "Exhibit B," and "Exhibit C," pursuant to 37 CFR § 1.132, to address certain secondary considerations to respectfully traverse the obviousness rejection. E.g., Graham v. John Deere Co. of Kan. City, 383 U.S. 1, 17-18 (U.S. 1966) (finding that secondary considerations such as commercial success and long felt but unsolved needs are relevant to non-obviousness).

Long Felt Need

Prior to the development of the technology of the instant application (embodied in the GTE-400 product), a long-felt but unresolved need in the turbine industry was the identification of a method to effectively clean the first three (3) to five (5) stages of a compressor while the gas turbine is in full operation. See Wagner Decl. ¶ 12. Prior to the GTE-400, in order to effectively clean the first three (3) to five (5) stages of a compressor, it was required to use off-line water washing. Id. In

off-line washing, the gas turbine is not in operation, i.e. does not burn fuel, but instead is rotated with the aid of the start motor of the gas turbine. Id. ¶¶ 11-12. Off-line washing has the drawback that the gas turbine is required to be taken out of operation during the cleaning process. Id.

Where prior systems were attempted to be used for on-line washing, cleaning of the first three (3) to five (5) stages of the compressor was ineffective, which was attributed in part to the high temperatures of the gas turbine during operation, which typically surpass 100C. Id. ¶ 12. In addition, prior to the instant application, it was also recognized in the industry that such prior systems used for off-line water wash had limitations as to how clean they would actually make the compressor, which resulted with frequent shutdown of the gas turbines for subsequent cleaning. Id.

Failure of Others

Prior to the instant application, others had tried but failed to make a product similar to the product embodied in the instant application suitable for on-line washing. Id. ¶ 13. Prior art systems and methods, which introduced a spray upstream the acceleration duct, produced large differences between the final speeds of spray drops and air after acceleration through the acceleration duct. Id. ¶ 17. The difference in speed between the drops and air is known as a "slip speed." Id. A "slip ratio" is defined as the ratio between the drop speed and the air speed, the drop speed constituting numerator and the air speed constituting denominator. Id. The low slip ratio in prior art systems substantially precluded the spray from traveling through compressor stages three (3) to five (5) with online washing because the drops encounter the blades and guide vanes unfavorably. Id. The instant application solves this problem by locating nozzles in the acceleration duct, which achieve higher slip ratios, for example, which is defined as at least 0.8 in claims 11 and 21 and at least 0.9 in claim

16. Id. This higher slip ratio allows the drops to move through compressor stages 3-5 during on-line washing. Id.

As an example, a company by the name of Statoil ASA ("Statoil"), a large gas turbine operator in Europe, in the late 1990's had a need to obtain more operating time on the gas turbines that were applied on offshore platforms. Id. ¶ 13. Statoil conducted a global search for technology to enable longer operating periods between compressor off-line water wash. Id. The numerous companies that Statoil contacted had attempted but failed to provide a satisfactory solution. Id.

GTE developed the technology of the instant application, which utilized an on-line wash process to clean the early compressor stages. Id. The GTE approach was the only suitable technology identified in Statoil's search. Id. Through use of the GTE system, Statoil achieved a 2% turbine availability improvement due to its ability to employ on-line water wash for its gas turbines, which resulted in millions of dollars of additional production time since the gas turbines could continue to operate during cleaning. Id.

Unexpected Results

Locating a nozzle at the acceleration duct produced unexpected results, as it was realized that compressor performance is maintained for a longer period of time. Id. ¶ 18. The attached Exhibit A of Wagner's Declaration shows the difference between an off-line wash on an industrial turbine using a conventional system, which employs a nozzle located in the low pressure area, and the technology of the instant application. Id. ¶ 18; Ex. A.

The use of the technology of the instant application for off-line washing recovers greater output power from the gas turbine than the conventional approach; in particular, about 35 3/4 MW for the conventional approach and 36 3/4 MW for the technology of the instant application, as shown

in Exhibit A. Id. In addition, when the technology of the instant application is used for off-line washing, the power level is maintained for about two (2) to four (4) times longer than the conventional approach before another off-line wash is needed (i.e., 3200 hours for the technology of the instant application as compared to 800 hours for the conventional approach). Id. Moreover, the power output is maintained at a higher level between off-line washes using the technology of the instant application, which goes no lower than 35 1/2 MW, as compared to the conventional approach, which drops to a low of slightly less than 33 MW. Id.

Commercial Success

GTE has achieved much commercial success with its Water Wash Product Line including the GTE-400, which incorporates the novel features described above and claimed in the present application. Id. ¶¶ 19-21. Gross revenues for 2008 for the GTE Water Wash Product Line are forecast to be $9 Million, which is approximately 26% of GTE's total revenues. Id. ¶ 19.

Moreover, Statoil uses the GTE-400 across its entire fleet and has reduced its wash time from three (3) hours to ten (10) minutes. Id. ¶¶ 7, 13; Ex. B. Fortum Oil & Gas has also endorsed the GTE-400 and it has experienced performance improvements of at least 10%. Id. ¶ 13; Ex. C. The GTE-400 is also used by numerous other oil and gas companies, including SNAM from Italy and Hawaiian utility- Kapaia Power Station, Kauai Island Utility. Id. ¶ 13.

Because of the success of the GTE-400, there are several companies that have recently began to offer products similar to the GTE-400, which incorporate the novel feature described above and claim herein, including RCM, ECT Inc., Dectron Internationale Inc. and AeroWash Inc. Id. ¶ 20.

The commercial success of the GTE-400 is directly attributable to the novel features described above and claimed in the application. Id. ¶ 21.

Conclusion

In view of the foregoing, the Applicant respectfully submits that the entire application is now in condition for allowance, which action is earnestly solicited.

Respectfully submitted,

Michael Burns

Paul A. Taufer
Reg. No. 35,703
Michael L. Burns
Reg. No. 57,593
Attorneys for Applicants

PAT/MLB/nn
(215) 656-3385